D.) AMENDMENTS TO THE DRAWINGS

None.

E.) REMARKS

This Response is filed in response to the Final Office Action dated March 9, 2005.

Upon entry of this Response, claims 1-21 will be pending in the Application.

In the outstanding Final Office Action, the Examiner maintained the objection to the drawings; and rejected claims 1-20 under 35 U.S.C. § 103(a) as being unpatentable over the Barka et al. article from 1999 entitled "An Efficient Algorithm for the RCS Modulation Prediction from Jet Inlet Engines" in view of the D'Angelo et al. article from 1993 entitled "A New Finite Element Formation for RF Scattering by Complex Bodies of Revolution."

Rejection under 35 U.S.C. 103

The Examiner rejected claims 1-20 under 35 U.S.C. § 103(a) as being unpatentable by the Barka et al. article from 1999 entitled "An Efficient Algorithm for the RCS Modulation Prediction from Jet Inlet Engines," hereinafter referred to as "the Barka Article," in view of the D'Angelo et al. article from 1993 entitled "A New Finite Element Formation for RF Scattering by Complex Bodies of Revolution," hereinafter referred to as "the D'Angelo Article."

Specifically, the Examiner stated that

> Barka et al. teaches using electromagnetic scattering from the interior of a complex jet engine inlet to contribute to the overall radar cross section (RCS) of a modern jet aircraft; but does not teach specific axi-symmetric aircraft related devices. D' Angelo et al. teaches solving electromagnetic scattering from complex inhomogeneous axi-symmetric bodies using finite element analysis.
>
> At the time the invention, it would have been obvious to one of ordinary skill in the art to use Barka et al. to modify D' Angelo et al. since it would be advantageous to capture the RCS from another dimension in space for a precise 3-D representation (D'Angelo: pg. 534, right column 2nd paragraph, lines 1-15 with equations 1,2).
>
> Claim 1. A method of calculating a radar cross section of an aircraft component having an axi-periodic structure comprising the steps of (Barka: pg. 2566, lines 1-3 and 11; D'Angelo: pg.534, abstract): creating a finite element model for the aircraft component describing electromagnetic characteristics of the aircraft component (Barka: pg. 2566, Introduction); transforming the finite element model into a plurality of independent modes (Barka: pg. 2567, lines 11-12); determining, for each independent mode of the plurality of independent mode (Barka: pg. 2566, lines 19-22); a portion of an electromagnetic field contributed by each independent mode (Barka: pg. 2567, lines 11-12); summing the portion of

the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic field for the aircraft component (D'Angelo: pg. 538, equation 21); and determining the radar cross section for the aircraft component from the total electromagnetic field (Barka: Introduction; D'Angelo: section III, Radar Cross Section Calculation, pg.537-539). ...

Claim 13. A computer program (Barka: pg. 2567, lines 5-12) product embodied on a computer readable medium and executable by a computer for calculating the radar cross section (RCS) of an aircraft engine face component, the computer program product comprising computer instructions for executing the steps of creating a finite element model for the aircraft engine face component describing electromagnetic characteristics of the aircraft engine face component (Barka: pg. 2566, lines 1-3 and 11; D'Angelo: pg.534, abstract); transforming the finite element model into a plurality of independent modes(Barka: pg. 2567, lines 5-12); determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode (Barka: pg. 2567, lines 18-34); summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic far-field for the aircraft engine face component (D'Angelo: pg. 537, equation 17); and determining the radar cross-section for the aircraft engine face component from the total electromagnetic far-field (D'Angelo: pg.537, equation 18). ...

Claim 17. A system for calculating the radar cross section (RCS) of an aircraft engine component comprising (Barka: pg. 2566, lines 1-3 and 11; D'Angelo: pg.534, abstract): a computer having memory and a processing unit; means for creating a finite element model for the aircraft engine component describing electromagnetic characteristics of the aircraft engine component (Barka: pg. 2566, lines 1-3 and 11; D'Angelo: pg.534, abstract); means for transforming the finite element model into a plurality of independent modes (Barka: pg. 2566, lines 11-18); means for determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic near-field contributed by each independent mode (Barka: pg. 2566, lines 11-18 and pg. 2567, lines 21-22); and means for summing the portion of the electromagnetic near-field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic near-field for the aircraft engine component(Barka: pg. 2566, lines 11-18); means for determining a total electromagnetic far-field for the aircraft engine component from the total electromagnetic near-field for the aircraft engine component(Barka: pg. 2566, lines 11-18); and means for determining the radar cross section for the aircraft engine component from the total electromagnetic far-field (Barka: pg. 2567, lines 18-34).

Applicants respectfully traverse the rejection of claims 1-20 under 35 U.S.C. § 103(a).

The Barka Article, as understood, is directed to an algorithm providing the radar modulation due to a set of rotating blades computed with only one solution for any blade position. The algorithm is used with a multidomain and multimethod coupling scheme based on generalized scattering matrix computations that is suitable in a context of parametric investigations. The algorithm writes the scattering matrix in a new base using a passing matrix. The passing matrix for a rotation angle has been shown to be analytical along with the inverse for the passing matrix and both the passing matrix and its inverse has no more than two non-zero coefficients in each row. The scattering matrix for a blade position is then determined in terms of the passing matrix and its inverse. Finally, the total number of operations that are needed to determine the scattering matrices associated with a set number of different positions of the engine blades is based on the total number of edge unknowns and the number of modal functions on the interface.

The D'Angelo Article, as understood, is directed to a design tool that provides information on scattering and radiation from complex objects that are axially symmetric. A direct three component formulation is used to solve for all three components of the electrical and magnetic fields over the domain of computation. An absorbing boundary condition is then performed directly without any interpolations to truncate the open regions surrounding the scatterer. The tool uses a final model Galerkin-finite element form for a given modal field to give the near fields inside the truncated domain. The radar cross section can be computed using a harmonic series expansion or a Green integral representation.

In contrast, independent claim 1 recites a method of calculating a radar cross section of an aircraft component having an axi-periodic structure comprising the steps of: creating a finite element model for the aircraft component describing electromagnetic characteristics of the aircraft component; transforming the finite element model into a plurality of independent modes; determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent

modes to calculate a total electromagnetic field for the aircraft component; and determining the radar cross section for the aircraft component from the total electromagnetic field.

Independent claim 13 recites a computer program product embodied on a computer readable medium and executable by a computer for calculating the radar cross section (RCS) of an aircraft engine face component, the computer program product comprising computer instructions for executing the steps of: creating a finite element model for the aircraft engine face component describing electromagnetic characteristics of the aircraft engine face component; transforming the finite element model into a plurality of independent modes; determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic far-field for the aircraft engine face component; and determining the radar cross section for the aircraft engine face component from the total electromagnetic far-field.

Independent claim 17 recites a system for calculating the radar cross section (RCS) of an aircraft engine component comprising: a computer having memory and a processing unit; means for creating a finite element model for the aircraft engine component describing electromagnetic characteristics of the aircraft engine component; means for transforming the finite element model into a plurality of independent modes; means for determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic near-field contributed by each independent mode; and means for summing the portion of the electromagnetic near-field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic near-field for the aircraft engine component; means for determining a total electromagnetic far-field for the aircraft engine component from the total electromagnetic near-field for the aircraft engine component; and means for determining the radar cross section for the aircraft engine component from the total electromagnetic far-field.

To begin Applicant would like to point out the following:

> To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C.

> 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

See Manual of Patent Examining Procedure, 8th Edition (MPEP) § 2143.03.

Several of the features recited by Applicant in independent claims 1, 13 and 17 are not taught or suggested by the D'Angelo Article and the Barka Article. First, neither the D'Angelo Article nor the Barka Article teaches or suggests transforming the finite element model into a plurality of independent modes as recited by Applicant in independent claims 1, 13 and 17. In the D'Angelo Article, the radar cross section is calculated by using a harmonic series expansion or Green integral representation on the final model Galerkin-finite element form. In the Barka Article, the scattering matrix is to be written in a new base and is then defined in terms of a passing matrix. The Examiner alleges that the Barka Article discloses the transformation of the finite element model into a plurality of independent modes at page 2567, lines 5-12. However, this passage discusses the use of the passing matrix as described above. Applicant submits that the changing of the base of the scattering matrix with the passing matrix is not a transformation of the finite element model and furthermore, the usage of the passing matrix in the Barka Article does not result in a plurality of independent modes as recited by Applicant in the independent claims. The Examiner is requested to explain how the changing of the base of the scattering matrix with a passing function, which results in a scattering matrix, can be considered a transformation into a plurality of independent modes.

The Examiner has stated in the Final Office Action (in response to Applicant's prior arguments), after discussing the Conclusions section in the D'Angelo Article, that "the examiner fails to understand the distinction between 'transformation' and 'changing of the scattering matrix with the passing matrix'." First, Applicant does not understand the reference to the the D'Angelo Article by the Examiner as the scattering matrix and passing matrix are discussed in the Barka Article and are not present in the D'Angelo Article. In response to the Examiner's statement that he does not see a distinction between "transformation" and "changing of the scattering matrix with the passing matrix," Applicant would like to point out that Applicant's recited limitation is "transformation into a plurality of independent modes." The Examiner has failed to identify or discuss how the changing of the scattering matrix with the passing matrix in

the Barka Article results in a plurality of independent modes. As discussed above, the usage of the passing matrix in the Barka Article does not result in a plurality of independent modes as recited by Applicant in the independent claims. Thus, since the D'Angelo Article and the Barka Article do not teach or suggest all of the limitations recited in independent claims 1, 13 and 17, Applicant respectfully submits that the D'Angelo Article and the Barka Article do not render Applicant's invention as recited in independent claims 1, 13 and 17 obvious.

Furthermore, the D'Angelo Article and the Barka Article do not teach or suggest additional features recited by Applicant in independent claims 1, 13 and 17, including, determining, for each independent mode of the plurality of independent modes, a portion of an electromagnetic field contributed by each independent mode; and summing the portion of the electromagnetic field contributed by each independent mode of the plurality of independent modes to calculate a total electromagnetic field for the aircraft component. For the reasons discussed above, Applicant submits that the the D'Angelo Article and the Barka Article do not teach or suggest these features as they do not teach or suggest a plurality of independent modes. Furthermore, Applicant would like to point out that the Examiner has alleged that the the Barka Article teaches the transformation into the plurality of independent modes and the determination of the electromagnetic field for each independent mode, but then alleges that the the D'Angelo Article teaches the summing of electromagnetic field for each independent mode. Applicant submits that the the D'Angelo Article cannot teach or suggest this limitation as the the D'Angelo Article does not teach or suggest an independent mode as acknowledged by the Examiner in the outstanding office action by referring to the the Barka Article.

The Examiner has stated in the Final Office Action (in response to Applicant's prior arguments) that the D'Angelo Article teaches at Equation 3 the determining of portions of an electromagnetic field and at Equation 7 the summing the portion of the electromagnetic field contribution. In response, Applicant would like to point out that Equation 3 in the D'Angelo Article refers to the incident magnetic field and not an electromagnetic field. Furthermore, Equation 3 in the D'Angelo Article does not include the scattering matrix from the Barka Article, which the Examiner has stated includes the plurality of independent modes and to which Applicant disagreed with the Examiner. Also, it is pointed out that Equation 7 in the D'Angelo

Article is 1) not summing the incident magnetic field from Equation 3 in the D'Angelo Article, but in fact performing a decomposition of the scattered magnetic field into azimuthal modes and 2) not directed to electromagnetic field as recited by Applicant. Thus, since the D'Angelo Article and the Barka Article do not teach or suggest all of the limitations recited in independent claims 1, 13 and 17, Applicant respectfully submits that the D'Angelo Article and the Barka Article do not render Applicant's invention as recited in independent claims 1, 13 and 17 obvious.

Next, Applicant respectfully submits that the Examiner has improperly combined the D'Angelo Article and the Barka Article. The Examiner has provided no teaching or suggestion in the D'Angelo Article that would indicate the desirability of incorporating into the D'Angelo Article the modulation algorithm of the Barka Article, nor has the Examiner cited any passage in the Barka Article that would indicate that the modulation algorithm can be used in the finite element formulation of the D'Angelo Article. The Examiner has only made a conclusory statement that it would be "obvious to one of ordinary skill in the art to use Barka et al. to modify D' Angelo et al. since it would be advantageous to capture the RCS from another dimension [in] space for an precise 3-D representation." Further, the Examiner has repeated these conclusory statements in the Final Office Action (in response to Applicant's prior arguments) and apparently added a different and unsupported motivation to combine the D'Angelo Article and the Barka Article that relates to the determination of a radar cross section analysis. However, the Examiner provides no support for this conclusion in either the D'Angelo Article or the Barka Article. Thus, Applicant respectfully submits that the Examiner has reached his conclusion based on the teachings in Applicant's specification, which is impermissible hindsight reasoning by the Examiner.

> In making the assessment of differences, section 103 specifically requires consideration of the claimed invention "as a whole." Inventions typically are new combinations of existing principles or features. *Envtl. Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 698 [218 USPQ 865] (Fed. Cir. 1983) (noting that "virtually all [inventions] are combinations of old elements."). The "as a whole" instruction in title 35 prevents evaluation of the invention part by part. Without this important requirement, an obviousness assessment might break an invention into its component parts (A + B + C), then find a prior art reference containing A, another containing B, and another containing C, and on that basis alone declare the

> invention obvious. This form of hindsight reasoning, using the invention as a roadmap to find its prior art components, would discount the value of combining various existing features or principles in a new way to achieve a new result – often the very definition of invention.
>
> Section 103 precludes this hindsight discounting of the value of new combinations by requiring assessment of the invention as a whole. This court has provided further assurance of an "as a whole" assessment of the invention under §103 by requiring a showing that an artisan of ordinary skill in the art at the time of invention, confronted by the same problems as the inventor and with no knowledge of the claimed invention, would select the various elements from the prior art and combine them in the claimed manner. In other words, the examiner or court must show some suggestion or motivation, before the invention itself, to make the new combination. See In re Rouffet, 149 F.3d 1350, 1355-56 [47 USPQ2d 1453] (Fed. Cir. 1998).

Ruiz v. A.B. Chance Co., 69 USPQ2d 1686, 1690 (Fed. Cir. 2004)

Applicant submits that the Examiner has impermissibly used Applicant's invention to find its components in the prior art. In the Final Office Action, the Examiner appears to pick and choose features from either the D'Angelo Article or the Barka Article to address particular features recited by Applicant in the claims without any further explanation. This is shown in the Examiner's reasoning regarding the independent modes discussed above, wherein the Barka Article is alleged to teach features relating to the independent modes and then suddenly, the D'Angelo Article is alleged to teach features relating to the independent modes.

Furthermore, "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art suggests the desirability of the combination." *See* Manual of Patent Examining Procedure, 8th Edition (MPEP), Section 2143.01.

In this case the D'Angelo Article explicitly teaches away from the advantage cited by the Examiner in the Office Action. The D'Angelo Article states in the Abstract that the "finite element mesh is truncated using a three-dimensional vector absorbing boundary condition." Thus, it appears to be clear that the the D'Angelo Article is already a precise 3-D representation, and if it is simplified to 2-D, it is simplified on purpose (see the D'Angelo Article, page 535, right-hand column), therefore, there appears to be no need for the advantage proposed by the Examiner because the D'Angelo Article is already a 3-D representation. The Examiner is

reminded that "[i]f the proposed modification or combination of the prior art would change the principle or operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." *See* MPEP, Section 2143.01.

Therefore, for the reasons given above, independent claims 1, 13 and 17 are believed to be distinguishable from the D'Angelo Article and the Barka Article and therefore are not anticipated nor rendered obvious by the Barka Article.

Dependent claims 2-12, 14-16 and 18-20 are believed to be allowable as depending from what are believed to be allowable independent claims 1, 13 and 17 for the reasons given above. In addition, claims 2-12, 14-16 and 18-20 recite further limitations that distinguish over the applied art.

For example, claim 3 recites a Discrete Fourier Transform, which is clearly not taught or suggested by either the D'Angelo Article or the Barka Article. The Examiner has stated in the Final Office Action (in response to Applicant's prior arguments) that "Equation 7 of D'Angelo is an example of an indefinite Fourier Transform with limits or boundary conditions, thus becoming a discrete Fourier transform (i.e., equation 9 D'Angelo)." In response to the Examiner's statements, Applicant cannot determine any relationship between equations 7 and 9 in the D'Angelo Article as set forth by the Examiner and thus, submits there is no Discrete Fourier Transform as recited by Applicant in claim 3. Equation 7 in the D'Angelo Article is a decomposition of the scattered magnetic field into azimuthal modes and Equation 9 in the D'Angelo Article is a family of absorbing boundary conditions based on the Wilcox expansion theorem. *See* the D'Angelo Article, page 535. The Examiner is requested to identify the specific passage(s) in the D'Angelo Article that link Equations 7 and 9. It is also noted that the Examiner has stated that Equation 7 of the D'Angelo article also allegedly teaches summing the portion of the magnetic field contribution. *See* Final Office Action, pages 2-3. Finally, the Examiner attempts to show the teaching of a Discrete Fourier Transform in the Abstract of the D'Angelo Article by reference to Applicant's Specification. *See* Final Office Action, page 3. Based on this language and reasoning it appears that the Examiner has reached his conclusion based on the

teachings in Applicant's specification, which is impermissible hindsight reasoning by the Examiner.

Claim 6, recites creating a mathematical representation of a reference pipe having an infinite length and using the mathematical representation of the reference pipe to determine the portion of the electromagnetic field contributed by each independent mode, which limitations are clearly not taught or suggested by either the D'Angelo Article or the Barka Article. The Examiner alleges that these limitations are taught by the D'Angelo Article at page 540, lines 8-31 and at pages 539-540, Results and Discussion. However, the passage(s) identified in the D'Angelo article by the Examiner relates to the validation of the code by considering several different geometries, including "a finite circular cylinder." Thus, there is nothing in D'Angelo that teaches the creation of a mathematical representation of **a reference pipe having an infinite length** as recited by Applicant in claim 6 (emphasis added). The Examiner is asked to specifically identify where in D'Angelo a reference pipe having an infinite length is taught or suggested. Furthermore, since D'Angelo does not teach or suggest a reference pipe having an infinite length, D'Angelo cannot teach or suggest using the reference pipe to determine the portion of the electromagnetic field contributed by each independent mode as also recited by Applicant in claim 6.

To further elaborate, the reference pipe having an infinite length or "infinite pipe" is used to model the termination of the cavity. Here, the "infinite pipe" provides a reflection-less boundary condition to the finite element modeling of the electromagnetic fields within a propulsion cavity. This boundary condition is used for accurately determining the low field returns found in a low observable propulsion system. *See e.g.*, Applicant's Specification, page 9, lines 3-10.

It is also noted that claims 1, 16 and 18 recite that the aircraft component has an axi-periodic structure. The axi-periodic structure is a discrete rotationally periodic structure - i.e., an object which geometrically repeats itself in the azimuthal direction. *See e.g.*, Applicant's Specification, page 5, lines 6-16. This feature is not taught or suggested by the the D'Angelo Article or the the Barka Article. The D'Angelo article teaches and demonstrates the modal decomposition of a rotationally symmetric structure (a body of revolution). The Barka Article

uses modal decomposition of a cavity's cross-section in the transverse direction to the depth of the cavity. The Barka Article then models the cavity as a whole by coupling multiple modal decompositions taken at various cross-section stages. Neither the D'Angelo Article or the Barka Article have relevance to this Application.

In conclusion, it is respectfully submitted that claims 1-20 are not anticipated nor rendered obvious by the D'Angelo Article and the Barka Article and are therefore allowable.

Objection to the Drawings

The Examiner has apparently again maintained the objection to the drawings from the first Office Action, in which the Examiner requested the labeling of Figures 1-3 as prior art. Specifically, the Examiner stated "[c]learly, viewing figures 1-3 in question, without the specification, are simple geometric figures, thus the reasoning why each should be labeled as prior art." The Examiner also stated that "one has to disclose what pieces or sections of their invention are his/her own works."

Applicant respectfully traverses the objection to the drawings.

To begin, Applicant is confused by the conclusion drawn by the Examiner relating to the presence of "simple geometric figures" in the drawings. The Examiner is requested to further explain and cite the legal basis for the Examiner's conclusion on how a "simple geometric figure" in a drawing is related to its determination of whether or not it is to be labeled as "prior art." Applicant again submits that Figures 1-3 are illustrations that are used in understanding Applicant's invention and, as such, are part of Applicant's invention and not "prior art." To further elaborate, Figures 1-3 illustrate pieces or sections of the inventor's work and, as discussed above, form part of Applicant's invention. Provided below is Applicant's response to the objection to the drawings from the first Office Action which is still believed to be applicable to the Examiner's objection.

> Applicant disagrees with the Examiner's characterization of Figures 1-3 as "prior art" and submits that the Figures show concepts associated with Applicant's invention and, as such, are not prior art. Specifically, the Examiner is referred to 37 C.F.R. 1.81(b) which states that "[d]rawings may include illustrations which facilitate an understanding of the invention." In the present Application, Figures 1-3 provide illustrations of concepts that are used in understanding Applicant's invention and, as such, are not old or "prior art." Furthermore, it is unclear how Applicant's basic design model illustrated in

Figure 1 and described in Applicant's Specification at page 4, lines 11-27 can be considered "well-known."

Therefore, in view of the above it respectfully requested that the Examiner reconsider and withdraw the objection to the drawings.

Newly Added Claim

Claim 21 is added in this Response and includes combined subject matter from claims 1 and 6. Claim 21 is believed to be allowable for the reasons provided above with regard to both claims 1 and 6. Entry and allowance of claim 21 is respectfully requested as new no issues are raised by the addition of claim 21.

CONCLUSION

In view of the above, Applicant respectfully requests reconsideration of the Application and withdrawal of the outstanding objections and rejections. As a result of the remarks presented herein, Applicant respectfully submits that claims 1-21 are not anticipated by nor rendered obvious by the D'Angelo Article, the Barka Article or their combination and thus, are in condition for allowance. As the claims are not anticipated by nor rendered obvious in view of the applied art, Applicant requests allowance of claims 1-21 in a timely manner. If the Examiner believes that prosecution of this Application could be expedited by a telephone conference, the Examiner is encouraged to contact the Applicant.

The Commissioner is hereby authorized to charge any additional fees and credit any overpayments to Deposit Account No. 50-1059.

Respectfully submitted,
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